

Distribution and natural history of the cryptic Chameleon Dragon *Chelosania brunnea*: a review of records

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Abstract

The Chameleon Dragon *Chelosania brunnea* is a rarely encountered and poorly-known agamid lizard. A total of 103 records (58 specimen-backed) were collated to examine aspects of its biology. The Chameleon Dragon occurs widely across north and north-western Australia with the majority of records from Kakadu National Park (41% of all records), the Dampier Peninsula, Kimberley and Katherine areas, largely reflecting past wildlife survey effort. Climatic modelling using BIOCLIM predicted its occurrence in extensive areas of the Gulf of Carpentaria and southern Cape York. The Chameleon Dragon is arboreal, apparently sedentary, with almost all records from eucalypt forest and woodland. Breeding is highly seasonal with males observed mostly in May (apparently to select mates) and females recorded mostly in the mid-dry season (July-August) as they descend to dig nest holes. A juvenile has been recorded in January. Hot late dry season wildfires are probably the main threat to Chameleon Dragons. Suggestions are given for further study of this interesting species.

Introduction

The monotypic Chameleon Dragon *Chelosania brunnea* (Gray 1845) is a medium-sized (snout-vent 105 mm), large-headed, short-limbed agamid lizard that is restricted to the wet-dry tropical forests and woodlands of northern Australia (Cogger 1994). The Chameleon Dragon is named because of its superficial similarity to Chameleon Dragons (Family Chameleonidae), to which it is unrelated; a spectacular example of independent convergent evolution. Just two short notes, totalling fewer than 500 words, have been published on the species. Greer (1990) described the Chameleon Dragon as a 'peculiar beast about which little is known'.

Until the 1960s, the distribution of the Chameleon Dragon was reported as Western Australia (Worrell 1963), however this ignored museum specimen records from near Darwin and Arnhem Land, collected in the early 20th century. One of the first published field reports was in 1979, with notes on a significant range extension and behaviour (Husband 1979). After releasing a Chameleon Dragon, Husband (1979)

noted that 'when moving through the branches it was very chameleon-like, slowly almost mechanically moving from point to point...'. A second publication described basic details of reproduction (Pengilley 1982). Miles and Burbidge (1975) and Bush (1985) summarise several additional Western Australian observations.

This paper collates known records of the Chameleon Dragon (to August 2004), develops a predicted distribution by correlative bioclimatic analysis (BIOCLIM) and documents biological details (habitat use, breeding and seasonality) gathered from specimen and unpublished anecdotal records of biologists and field naturalists.

Methods

Data sources

Chameleon Dragon locality records were sought from Australian and international museums, from biological atlas/database schemes managed by Australian state and territory natural resource management departments, and by seeking published and unpublished site records from field biologists and herpetologists (all are listed in acknowledgements or cited in the text). Data sought was locality, georeference, date, habitat and behaviour.

Records with sufficient information on habitat were subjectively classified into five broad habitat types: eucalypt forest, eucalypt woodland, tropical dry forest (= monsoon rainforest), acacia woodland and urban gardens.

Predicting distribution

Known geo-referenced locality records ($n = 80$), except for the 23 records obtained after a June 1997 cut-off date, were entered into BIOCLIM to predict the distribution of the Chameleon Dragon. BIOCLIM is a bio-climatic analysis and prediction system, which can generate site-specific estimates of monthly temperatures and precipitation for sites anywhere in Australia. Results of this analysis are noted briefly.

Results and discussion

Known distribution

The Chameleon Dragon is widely distributed in Australia's wet-dry tropics across almost six degrees of latitude (12° – $17^{\circ}30'S$) and 16 degrees of longitude (122° – 138° E): a land area of c. 800,000 km². The known distribution of the Chameleon Dragon is given in Figure 1. The BIOCLIM-predicted distribution encompassed known records but furthermore predicted occurrence in the Qld Gulf of Carpentaria, where the Chameleon Dragon has never been recorded (but which has been little surveyed).

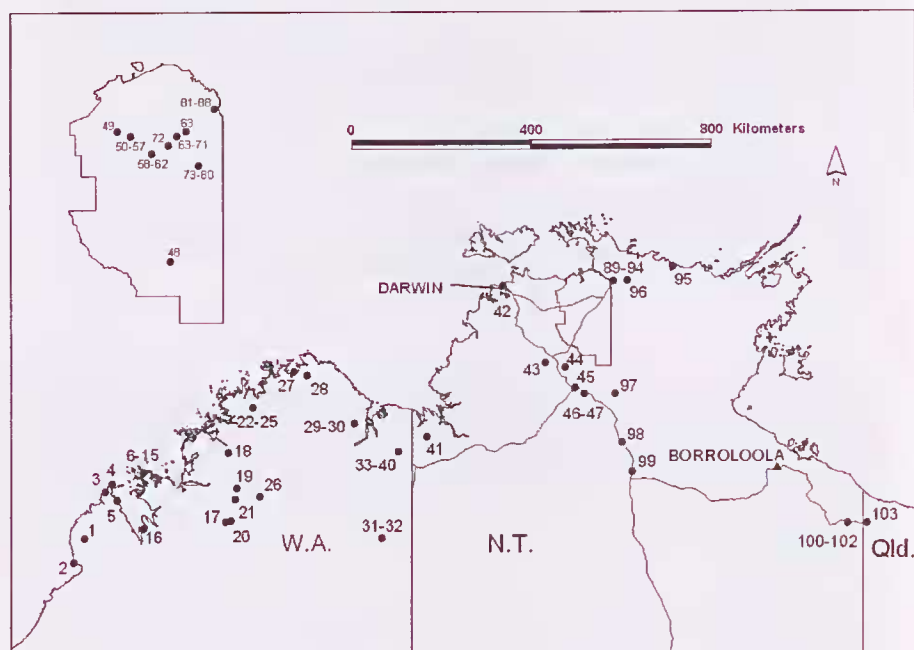


Figure 1. Distribution of the Chameleon Dragon. Location numbers are listed in the Appendix. The scale bar relates to the main map. The inset map is Kakadu National Park in the Northern Territory.

Western Australia

In WA the majority of records are specimen-based, with records from the Dampier Peninsula, Derby and Leopold Ranges area. Storr *et al.* (1983) list far north Western Australia including the Kimberley to Coulomb Point, King Leopold Range and Kununurra in its range. There are several records throughout the north Kimberley, Drysdale River National Park and Kalumburu area, but few from the central Kimberley Plateau, probably reflecting the lack of survey effort and inaccessibility of this area. Residents of Kununurra reported several observations of Chameleon Dragon within the town over the past 25 years (particularly at caravan parks), and there are two records from Bungle Bungle National Park (including a specimen).

Northern Territory

In the NT there is one record of this dragon from the far west, from Spirit Hills Station near Kununurra, with a major gap in distribution records between the Victoria-Bonaparte and Daly Basin districts (probably reflecting low survey effort in

this remote area). Similarly there is only one historical record of Chameleon Dragon for the Darwin area. Many biologists are based in Darwin, so this may represent a real range gap. Almost half of all known records are from Kakadu National Park (KNP) (particularly Kapalga Research Station, Jabiru, Nourlangie and Ubirr Rock) and Oenpelli in western Arnhem Land, highlighting the high field survey effort. There are several records for the Katherine and Mataranka districts, with only two in the Daly Waters-Sturt Plateau area (including Husband 1979). There are two (or three) records from the far west of the NT Gulf Region on Wollgorang Station. The pattern of records for the NT appears to reflect previous survey effort, but the increased frequency of records from the higher rainfall forests may also relate to a habitat preference.

Queensland

The Chameleon Dragon was included on the official wildlife list for Qld in 1991 (Covacevich and Couper 1991) because of 'an unambiguous photo' of a Chameleon Dragon taken in 1978 at 'Camp Ridgeway', between the NT/Qld border and the Westmoreland Station homestead by a geologist (H. Cogger, pers. comm.). It was subsequently removed from the list because no specimens were available (P. Couper, pers. comm.).

Habitat use

The Chameleon Dragon prefers eucalypt forests and woodlands, with few records from dry tropical forest (monsoon rainforest), floodplain, acacia woodland and urban areas (Cogger 1981; this review). There were two records from tropical dry forest (Figure 2) including a Wollgorang record where an individual was collected from a small patch of forest. Apart from the record by Husband (1979) from acacia woodland (presumably Lancewood *Acacia shirleyi* scrub), there was a single specimen collected from the same habitat near Kalumburu by the Australian Museum. One naturalist observed a Chameleon Dragon sleeping in 'Pindan' acacia trees north of Broome and suspects that they might be associated with acacia shrubland on deep sand (I. Morris, pers. comm.) but none were recorded during biological surveys targeting such shrubland (Woinarski & Fisher 1995a,b). There are two reports from the vicinity of towns: at Kununurra and Oenpelli, and several more undocumented reports from Jabiru (G. Miles, pers. comm.) (see Appendix).

Behaviour and microhabitat use

Chameleon Dragons are mostly arboreal and sedentary. Individuals are repeatedly observed at regular points along roads in KNP indicating that they occupy permanent territories (I. Morris, pers. comm.). A total of 10 individuals have been captured in pitfall traps in KNP (T. Hertog, pers. comm) and at Kalumburu (J. Wombey, pers. comm.). Trap capture rates are exceptionally low as the KNP data represent c. 4,000 pitfall trap nights over a 7 year period. Chameleon Dragons are most often observed

on the ground (on tracks, as road-killed individuals, basking, fighting or digging burrows), six have been observed low in trees and none have been recorded from the canopy (Table 1) although it is suspected that they spend most time at this level. They are probably experts at evasion, as they 'slip around the tree to avoid predators' (N. Gambold, pers. comm.). They are also inexplicably clumsy. One individual landed on the windscreen of a moving car, apparently after being captured and then released by a diurnal raptor (Museum and Art Gallery of the Northern Territory database). A Chameleon Dragon fell from the canopy of *Eucalyptus* woodland in Kakadu (A. Dudley, pers. comm.), and at Wollogorang a dragon fell from the canopy of eucalypt woodland onto a tent (C. Trainor, pers. obs.). Tony Griffiths (pers. comm.) observed a released animal climb, then fall off the lower trunk of a tree.

Little is known of diet. In Kakadu an adult male road-killed on 5 July 2002 had: "Stomach quite full; contained about 80 green ants [*Oecophylla smaragdina*], plus 4-5 square bits of bark. There was a fecal pellet in intestine, also wholly green ants" (S. Sweet, pers. comm.). A juvenile dragon has been observed feeding on Green Ants (I. Morris, pers. comm.). A ranger observed a juvenile sleeping/basking on a tree root in KNP (L. Barnett *per* I. Morris, pers. comm.). After release, a male animal at Kapalga slowly moved 2 m then climbed a *Eucalyptus tetrodonta* tree, moving its limbs slowly with little use of its hind feet while climbing. The tail is prehensile, and during this observation it was used to grip branches and other objects (T. Griffiths, pers. comm.).

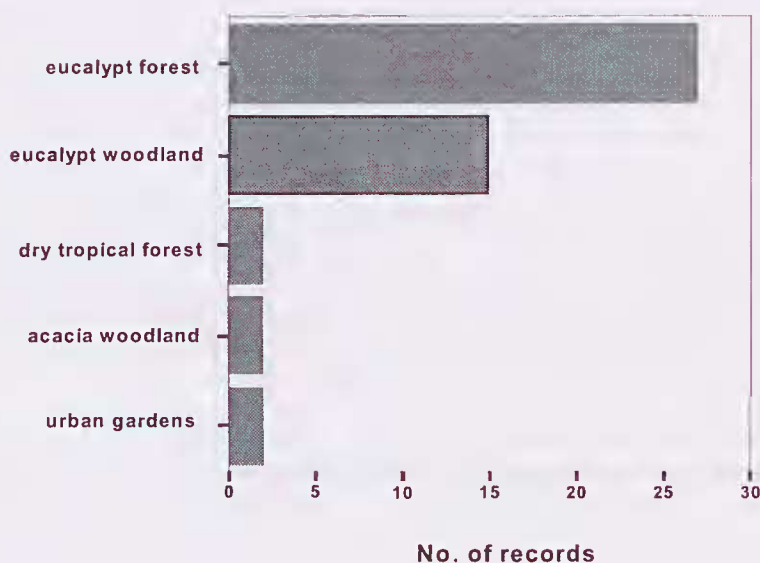


Figure 2. Frequency of occurrence of the Chameleon Dragon in broad habitat types.

Table 1. Frequency of occurrence of microhabitat use (including pitfall trap) by Chameleon Dragon when first sighted ($n = 41$ records). * = includes two records of an animal that fell to ground from the forest canopy, and one that was dropped to ground by a diurnal raptor.

| Microhabitat | Frequency |
|---|-----------|
| Pitfall trap capture | 10 |
| On low tree (<2 m) | 6 |
| On ground: stationary or crossing track | 10 |
| On ground | 5 * |
| On ground: road kill | 4 |
| On ground: digging burrow | 2 |
| On ground: territorial fight | 2 |
| On ground: with predator | 1 |
| On ground: basking | 1 |

Breeding, seasonality and detectability

Half of the 75 dated locality records are from July, August and September (Figure 3). Males are usually observed in May (5 of 9 records where sex known), and females in July and August (9 of 12 records where sex known). Presumably males descend at this time to take part in territorial fighting to establish mating rights (see below). In the following months, gravid females descend to the ground to lay eggs, with several direct observations of this behaviour (J. Wombey, pers. comm.). A juvenile dragon (snout-vent 53 mm, weight 3 g) was captured on 19 January 1979 (N. Sonnemann, pers. comm.), probably having hatched in the late dry season (September-October).

Basking by gravid females may increase detectability because they are heavier and less mobile than non-gravid individuals (G. Miles, pers. comm.). An adult female, suspected of being gravid, 'walked in a slow, rather jerky gait' after being released (J. Wombey, pers. comm.). Females are known to lay eight eggs (G. Miles, pers. comm.). The egg number, incubation period, egg and hatchling morphometrics of a purported single clutch was described by Pengilley (1982), but he had described the characteristics of two clutches rather than one (G. Miles, pers. comm.). It has been speculated that in the wet season they 'prefer sandy substrates which are boggy and impassable in the wet season', which may further reduce opportunities to observe dragons in this season (G. Miles, pers. comm.). The Chameleon Dragon may have

been observed less frequently in KNP since roads were upgraded to bitumen (c. 1985), because the black surfaces are too hot for basking and visual detection is reduced (I. Morris, pers. comm.).

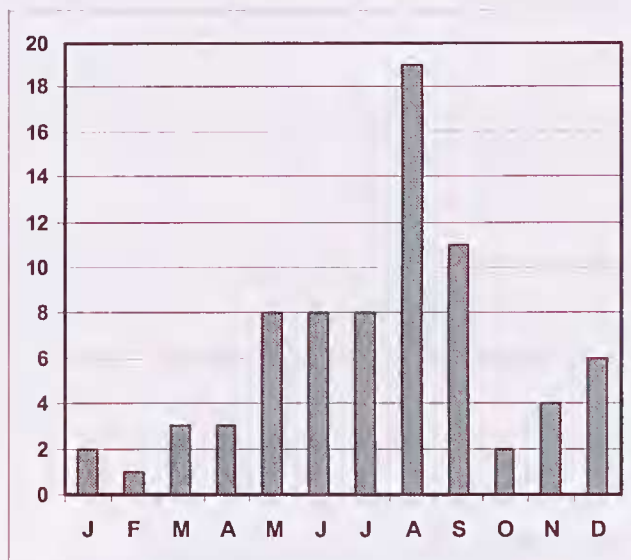


Figure 3. Number of monthly records of the Chameleon Dragon ($n = 75$ dated records).

Relative abundance

Little is known of the Chameleon Dragon's relative abundance, but field observations are infrequent. Several experts consider that they are not rare, but difficult to record unless gravid (P. Harlow and J. Wombey, pers. comm.) or involved in territorial fights. The number of records has increased greatly over the last three decades of the 20th century, with the intensification of biological field survey in northern Australia.

Major fauna surveys have been notably unsuccessful at recording Chameleon Dragons: one was recorded during surveys of KNP Stages 1 and 2 over about 3 person years (Braithwaite 1985); none were recorded in the KNP Stage 3 survey, involving about 200 person days (Woinarski & Braithwaite 1991), or during a Bungle Bungle National Park survey (Woinarski 1992). None were recorded during surveys of Litchfield, Elsey or Limmen Gate Nat. Parks (Griffiths 1997, Griffiths *et al.* 1997ab) or the continental Wessel and English Company Islands (Woinarski *et al.* 1999).

There are two confirmed observations of more than one individual. On 1 May 1979, two males were observed in a territorial fight in KNP, and then a female was observed nearby on the same day (J. Wombey, pers. comm.). At Kapalga, during June 1992, two males were observed by the author on the ground clasping each other's bodies while presumably fighting. Additionally, a total of 10 individuals were collected from the Wotjulum area of WA in 1954-1955 during museum surveys, which comprise almost all the records for that decade. Four individuals were observed in one day by a 'Mr Bishop' (N. Gambold, pers. comm.). At Kununurra four Chameleon Dragons were observed over 10 months in 1978-1979 (N. Sonnemann, pers. comm.) and in the Jabiru area of KNP, about eight Chameleon Dragons were collected over a 22 yr period (G. Miles, pers. comm.).

Possible threats

Hot late season fires which burn into the canopy would be the greatest threat to Chameleon Dragon populations, as most individuals would be killed by this regime. Limited data from the Kapalga Fire Experiment provides some support for this opinion. During reptile sampling, only seven Chameleon Dragons were captured over five years. Four were recorded in control years before the burning began (two in progressive burn samples and two in late burn samples). After the experiment began, Chameleon Dragons were recorded only in unburnt or early burn sites (T. Hertog, pers. comm.; the author, pers. obs.). Predation by Feral Cats *Felis catus*, has been suggested as threats to dragons (N. Gambold, pers. comm.; B. Hancock, pers. comm.). A cat was observed mauling a Chameleon Dragon at Kununurra (N. Sonnemann, pers. comm.). Chemical spraying (with dieldrin) has also been suggested as a cause of the reduced frequency of observations of dragons in the vicinity of the town of Jabiru (I. Morris, pers. comm.).

Conservation and suggestions for further study

Although rarely recorded, the Chameleon Dragon is not considered globally threatened (<http://www.redlist.org>, 2005) or regionally rare or threatened, however Gambold and Menkhorst (1992) used the presence of Chameleon Dragons as supporting evidence for a National Estate proposal. More than half of the 103 records are from protected areas (Table 2), reflecting survey effort in designated protected areas and presumably demonstrating that the network provides good coverage of dragon habitat.

There are at least 58 museum specimens (see Appendix) that could be analysed for study of diet, reproduction and genetics. Field studies will need to focus on active searching during the early and mid-dry season when males and females descend to the ground to mate and lay eggs. Pitfall trapping has rarely been successful. The Kununurra area, particularly around caravan parks, KNP area, Kalumburu and Cape Leveque may be suitable locations for field study. The Bardi people (at least) of the Dampier Peninsula are reputedly familiar with the Chameleon Dragon (I. Morris, pers.

comm.). Questionnaires and interview with Aboriginals over the range of the species, aiming to document local knowledge of occurrence, habitat use and behaviour also has potential to reveal new ecological details of this elusive dragon lizard.

Table 2. Frequency of Chameleon Dragon records ($n = 60$) from protected areas and Aboriginal Land Trusts in north-western Australia.

| <i>Protected areas</i> | <i>Area (km²)</i> | <i>No. records</i> |
|------------------------------------|------------------------------|--------------------|
| Kakadu National Park (KNP) | 20,000 | 42 |
| Umbrawarra Gorge Nature Park | 20 | 1 |
| Point Coulomb Nature Reserve | c. 200 | 1 |
| Drysdale River National Park | 7,000 | 3 |
| Bungle Bungle National Park | 3,100 | 2 |
| Cutta Cutta Caves Nature Park | 20 | 2 |
| Arnhem Land Aboriginal Land Trust | c. 60,000 | 8 |
| Prince Regent River Nature Reserve | 6,300 | 1 |

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Museum, London), Keith McDonald (QLD), Greg Miles (Department of Environment and Heritage, Jabiru), Nic Gambold (Central Land Council, Alice Springs), Ian Morris (Noonamah, NT), Cassy Redhed (Chicago Field Museum), Ross Sadlier (Australian Museum, Canberra), M. Ruf (Zoological Museum of Zurich), Rick Shine (University of Sydney), Martin Shultz (Southern Cross University), Neil Sonnemann, Laurie Smith (Western Australian Museum, Perth), Sam Sweet (University of California), Steve Wilson (Queensland Museum, Brisbane) and John Wombey (Australian National Wildlife Collection, CSIRO, Canberra).

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Appendix. Chameleon Dragon locality record details.

This appendix may be viewed at:

http://www.geocities.com/ntfieldnaturalists/journal/Trainor_appendix.pdf



The Chameleon Dragon *Chelosania brunnea* is arboreal, although females descend to the ground to dig nest holes. (Martin Armstrong)